

Programme I. PHYSICAL AND CHEMICAL APPLICATIONS

Rationale: Applications of radioisotopes and ionizing radiation in every sphere of science and technology are contributing significantly towards sustainable development and improving the quality of life. Many Member States have significant programmes in these areas and there is a continuous growth in these applications, including medical diagnosis and therapy, process industries and analytical sciences.

Objective: To increase Member State capabilities in the application of radioisotopes and radiation processing and as tools for sustainable economic development.

Outcomes
— Increased competence of national institutions for development and use of radioisotope products and radiation processes.
Performance Indicators
— Number of facilities participating in and benefiting from the Agency's programmes.
— Degree of implementation of quality systems in Member State laboratories/plants.

Subprogramme I.1. Radiochemical Applications

Problems and issues to be addressed by the Agency:

A number of Member States are successfully using radioisotopes in the developmental programmes of their countries and are exploring avenues for improving the methodologies and applications. At the same time, many developing Member States are actively pursuing work to incorporate this complex technology by adapting it to suit their specific needs. Improvement in methodologies and applications is a worldwide effort and is facilitated by Agency co-ordination to obtain efficient and cost effective solutions. The interest of developing Member States in this area is reflected by the increasing demand for technical co-operation and participation in Agency co-ordinated research. Building and sustaining capabilities in the Member States enables them to use these powerful tools of nuclear science in a wide spectrum of applications. Note has been taken of the recommendations of PPAS and SAGNA to link the relevant radiochemical projects to nuclear medicine projects.

Objective: To enhance the knowledge of Member States in methodologies for the production and increased availability of radioisotopes and the reliability of nuclear analytical and radiotracer methodologies.

Outcomes
— Enhanced capabilities in national radioisotope laboratories to produce radioisotope products and to adopt improved methods for isotope production as recommended by the Agency.
— Enhanced capabilities of national nuclear analytical laboratories to analyse radioactive and other important chemical species of interest and to adopt international standards for measurements through participation in the Agency's programme.
Performance Indicators
— Procedures developed for improved production of ^{201}Tl , ^{123}I , ^{103}Pd and ^{124}I radioisotopes and for preparation of $^{99\text{m}}\text{Tc}$ agent for infection imaging.
— Number of national nuclear analytical laboratories adopting international standards and receiving accreditation.

Programme changes and trends: In the area of radioisotopes and radiopharmaceuticals, there will be a shift towards the development of more organ specific agents based on biomolecules and small peptides and the development of therapeutic agents. In the area of measurements based on nuclear techniques, the new emphasis will be on enhancing the awareness and facilitation of the introduction of quality assurance (QA) practices in accordance with international standards.

Resource changes and trends: There is significant restructuring of the programme after 2001. However, the resources for activities under this subprogramme are similar to those in the budget for 2001.

Financial resources

	2001	2002	2003
Reg. budg.	1 585 000	1 610 000	1 628 000

Project I.1.01. Radioisotope production for specific applications

Main outputs: Co-ordinated research on cyclotron target technology will result in the development of improved or new laboratory procedures to manufacture high current solid cyclotron targets for the production of diagnostic and therapeutic radionuclides, including ^{201}Tl , ^{123}I , ^{124}I and ^{103}Pd , and a technical document describing the results of this research will be published. Through co-ordinated research, improved techniques and QA procedures for the production of small sealed sources based on ^{90}Sr , ^{90}Y for endovascular therapy and ^{125}I and ^{103}Pd for implantation therapy of prostate cancer will be developed. A technical document describing these procedures will be published. A guidebook on

modernization of radioisotope production laboratories incorporating internationally accepted standards will be prepared and published for the use of reactor and cyclotron groups. An updated edition of the directory on cyclotron facilities sustaining radionuclide production programmes will be published.

Duration: 2001–2004

Ranking: 1

Project I.1.02. Development of educational modules in radiochemistry and radioanalytical procedures for toxicological important species

Main outputs: A CRP will result in a number of validated procedures for As, Se and Cr speciation analysis in aqueous media and the resulting TECDOC with recommendations will be made available to help Member State laboratories to meet international standards for permissible levels in food, agriculture and environmental samples. Documents produced will contribute to improving the analytical capabilities in laboratories of Member States towards ISO 17025 compatible quality standards. Through the services of consultants and technical contracts, a modular training programme on the principles and practical aspects of radioanalytical and radiochemical methods will be developed to be implemented in local, regional and interregional training courses and university educational programmes.

Duration: 2001–2004

Ranking: 3

Project I.1.03. Development of laboratory methodologies for the production of specific radiopharmaceuticals and radioimmunoassay kits

Main outputs: Co-ordinated research in the field of radiopharmaceutical chemistry will result in the development of improved laboratory protocols for the preparation and quality control of new ^{99m}Tc based specific radiopharmaceuticals for metabolic and infection imaging, and a technical document describing the results of this research will be published. The CRP on therapeutic radiopharmaceuticals will develop laboratory methodologies and techniques to evaluate the relative merits of therapeutic radiopharmaceuticals labelled with beta emitting radionuclides such as ^{131}I , ^{32}P , ^{153}Sm , $^{186/188}\text{Re}$ will be developed. Regulatory guidelines for the production and quality control of radiopharmaceuticals will be elaborated and published jointly with WHO. A technical document outlining future trends in radiopharmaceutical research and development will be published. A CRP on radioimmunometric assays will

result in the development of new ^{125}I based assays for the determination of small molecules in non-clinical applications. High quality and inexpensive radioimmunoassay and immunoradiometric assay kits will help to demonstrate the value of nuclear based analytical tools.

Duration: 2001–2004

Ranking: 2

Project I.1.04. Analytical quality control services

Main outputs: This project, which is implemented as an ongoing service to the Member States, will provide laboratories worldwide with the opportunity to participate in 2 to 3 proficiency tests per year where the accuracy and precision of their radiochemical and chemical analyses will be assessed by comparison of reported results to known values and where analytical methodology will also be evaluated on the basis of responses to carefully designed and detailed questionnaires. The overall accuracy and performance of the participants will be improved both through the identification and elimination of sources of bias and through the adoption and implementation of standardized and robust procedures. Each year, the project will result in the preparation and characterization of 1 to 2 new candidate reference materials, the certification of 1 to 2 selected IAEA AQCS reference materials and the sale of 1000 to 1500 IAEA AQCS reference materials to laboratories in Member States. These reference materials, which will continue to be provided at minimal cost, will be used in laboratories in Member States to monitor the performance of methods and to demonstrate the accuracy and reliability of their methods and results both to national and international customers and authorities. Technical staff from laboratories in Member States will be trained in the use of modern nuclear and instrumental techniques for the analysis of radionuclides and elements of environmental importance. They will also be introduced to the principles of quality assurance according to ISO 17025, and trained in the appropriate use of reference materials for validation of methods and results. The project will also see the introduction and full implementation of a quality assurance system according to ISO 17025 for the laboratory carrying out this project together with the implementation of ISO Guides 34 and 35 concerning the preparation and production of AQCS reference materials.

Duration: Ongoing

Ranking: 4

Subprogramme I.2. Radiation Processing, Radiography and Radiotracer Applications

Problems and issues to be addressed by the Agency:

A number of Member States sustain active programmes on the utilization of radiation processing, radiotracers and radiography and are interested in the effective incorporation of novel aspects of these nuclear technologies to industrial sectors for specific applications as well as to improve the local expertise. The interest of Member States is reflected in the increasing demand for participation in Agency's co-ordinated research and technical co-operation projects.

Objective: To increase the capabilities of Member States to sustain industrial applications of: radiotracers and sealed sources in exploitation of natural resources, particularly oil-gas and minerals; radiation processing to improve physico-chemical characteristics of polymers for separation purposes and for remediation of drinking water and industrial waste water; and industrial radiography for determination of corrosion in metallic pipes.

Outcomes
<ul style="list-style-type: none"> — Enhanced capability in national radioisotope laboratories to apply radioisotope techniques in petroleum and chemical industry to improve safety and efficiency through participation in the Agency's programme. — Enhanced capability in national laboratories for radiation processing of materials through participation in the Agency's programmes.
Performance Indicators
<ul style="list-style-type: none"> — Protocols developed for applications of radiotracer techniques in oil/gas fields exploitation and number of radiography personnel certified. — Protocols developed for radiation synthesis of materials for separation processes and radiation assisted waste water treatment.

Programme changes and trends: In the field of radiation processing, there will be a shift from product sterilization to developing improved physico-chemical characteristics of polymeric materials and liquid waste treatment. In the area of radiotracers, the emphasis will be on applications to optimize engineering processes for the exploitation of natural resources. In the area of industrial radiography, emphasis will be put on the development of standard protocols for the evaluation of corrosion of metallic structures. The Agency will assist Member States in the development and testing of devices to identify buried landmines.

Resource changes and trends: There is significant restructuring of the programme after 2001. However, the resources for activities under this subprogramme are similar to those in the budget for 2001.

Financial resources

	2001	2002	2003
Reg. budg.	805 000	775 000	754 000

Project I.2.01. Radiotracers and sealed sources for mineral recovery optimization and flow pattern visualization

Main outputs: Under this project, co-ordinated research on new applications of radiotracers in the field of oil-gas and mineral exploitation will result in the development of methodologies and testing for reservoir oil estimation and in validation of low activity nucleonic gauges for mineral recovery optimization. These results will be published as a TECDOC. Through co-ordinated research, validation of real time imaging techniques for flow pattern visualization inside processing vessels for detecting process troubleshooting and improving design and operation of industrial process units will be developed on a laboratory scale. Also, contract holders and counterparts will be trained in the use of computer transmission and emission tomography, as well as single particle tracking for constructing 2D and 3D flow pattern maps inside multiphase systems. Laboratory protocols and guidelines on real time imaging techniques in fluidized beds and mixers will be published in the form of technical documents. Draft ISO standards for radiotracer interwell communication and low activity borehole logging will be prepared.

Duration: 2002–2005

Ranking: 1

Project I.2.02. Modification of polymers and remediation of drinking water and industrial wastewater

Main outputs: Under this project, a CRP on radiation synthesis and modification of separation agents will result in the publication of a TECDOC that will contain state-of-the-art information and procedures on the use of heavy ion irradiation for the production of track membranes and radiation grafting and cross-linking processes for the tailor synthesis of stimuli-responsive (pH, temperature, ionic strength) ion tracks, adsorbents and hydrogels to be used in separation processes. Guidelines to be prepared as a result of a CRP on radiation treatment of drinking water and wastewater will provide technical information and criteria on the selection, optimization and implementation of radiation technology, and its combination with conventional techniques to achieve

a synergistic effect. A technical document compiling the scientific findings, especially on toxicity effects, dosimetry of flow systems and under beam handling systems will be published. Technical staff of the institutions involved in CRP and technical co-operation projects will be trained on the use of radiation technology to tackle their environmental problems and to better utilize their indigenous resources by producing value-added products.

Duration: 2001–2004

Ranking: 3

Project I.2.03. Development of procedures and standard protocols for radiography techniques

Main outputs: Within this project, co-ordinated research will result in the development of procedures and standard protocols for corrosion and deposit determination in large diameter pipes by radiography. These will be described in a TECDOC publication. A draft ISO standard will be prepared and submitted to ISO for approval following its own procedure. Other publications will include: a guidebook on digital industrial radiology, a training course series publication on leak testing at Level 2, a guidebook on

non-destructive evaluation and plant life assessment and a revised version of TECDOC-628 on “Training guidelines for non-destructive testing techniques”. Regional training courses will be organized, focused on producing Level 3 personnel in order to help Member States in the establishment of NDT technology on a sustainable basis.

Duration: 2002–2004

Ranking: 4

Project I.2.04. Application to landmine identification

Main outputs: The Agency will participate in international forums on humanitarian demining, and a CRP will facilitate the development and testing of nuclear instruments for the identification of landmines.

Duration: 2002–2004

Ranking: 2